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1. Your reference	MOC/AW
2. Patent application number *(The Patent Office will fill in this part)*	17 JUL 2003 0316733.5
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	JAMES THOMPSON 18 GLENLOUGHAN ROAD KILKEEL COUNTY DOWN BT34 2SR NORTHERN IRELAND
Patents ADP number *(if you know it)*	08676108001
If the applicant is a corporate body, give the country/state of its incorporation	
4. Title of the invention	SEATING FOR A PASSENGER VEHICLE
5. Name of your agent *(if you have one)*	
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	4 MOUNT CHARLES BELFAST BT7 1NZ NORTHERN IRELAND
Patents ADP number *(if you know it)*	08676116001

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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*
	—	

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))*	NO

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Description 10

Claim(s) 0

Abstract 0

Drawing(s) 13

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Priority documents 0

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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)* 0

Request for preliminary examination and search *(Patents Form 9/77)* 0

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11. I/We request the grant of a patent on the basis of this application.

Signature A Wallace Date 17/7/03

ALAN WALLACE, AGENT

12. Name and daytime telephone number of person to contact in the United Kingdom ALAN WALLACE 02890 236000

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Seating for a passenger vehicle

This invention relates to seating for a passenger vehicle. It has particular, but not exclusive, application to seating in a passenger carrying aircraft.

There are clear economic incentives that drive aircraft designers to provide as many seats as possible in a passenger aircraft. Yet there is a conflicting demand to provide those passengers willing to pay for premium services with a feeling of space and privacy. In particular, business class and first class passengers on long air journeys may be offered seats that recline and can be converted into a bed. Such seats are very attractive to passengers because of the comfort that they offer. However, they are less attractive from the point of view of the aircraft operator because they represent an inefficient use of space within the aircraft.

Although embodiments of the invention will be described with respect to application to aircraft, it is not limited to such applications. It may, for example, find application in other forms of transport such as ships, hydrofoils, trains and coaches and so forth, as well as in other circumstances not related to transport.

Therefore, it is an aim of this invention to provide a seating arrangement that can be used in passenger aircraft and in other circumstances that can provide an increase in passenger-carrying capacity without reducing (and maybe increasing) an occupant's perception of space.

From a first aspect, this invention provides a seating arrangement for a passenger-carrying vehicle the arrangement providing a plurality of seating positions, a seating position comprising a seat and a footwell, the footwell of a first seating position being located adjacent to the seat of a second seating position, the second seating position being located generally forward of the first seating position.

The positioning of the footwell adjacent to a seat in front allows the seats to be arranged in rows having a pitch that is less than in a conventional arrangement. While the transverse spacing between the seats must be greater than in a conventional arrangement, the overall effect is to provide a passenger with more space *per* unit of floor area occupied than is possible in a conventional arrangement. For a given floor area, embodiments of the invention may allow up to 17% more seats to be provided than can a conventional arrangement.

The invention has particular application to embodiments in which the seat can be reclined to enable a user to sleep. Unlike in conventional "lie flat at an angle" reclining seats, the footwell does not need to fit below a seat, so its height can be sufficient to accommodate an occupier's feet while the occupier is fully reclined.

When a seat in a seating arrangement is in a reclined position, a leg-supporting component of the seat may project into a footwell forward of that seat. The leg-supporting component may closely approach a platform within the footwell. This can be used to provide a sleeping platform that is longer than that which could be provided by components of the seat alone.

In a typical installation, an arrangement embodying the invention may include one or more groups in which seating positions are disposed in rows. For example, each row may be transverse to the normal direction of travel of the vehicle in which they are installed. Such groups may include rows having just one seating position. Alternatively or additionally, a group may have alternate rows having two and three seating positions respectively. In the latter case, most commonly found around the centre line of an aircraft passenger compartment a further advantage of embodiments of the invention becomes apparent. Most passengers can enter or leave their seat without disturbing any other passenger. Only occupiers within the central position of a three-seat row (or inner positions of longer rows) need disturb any other passenger, and a maximum of one other passenger need move for rows of three or four seating positions.

From a second aspect, this invention provides a passenger-carrying vehicle comprising a seating arrangement according to the first aspect of the invention. This aspect of the

invention offers particular advantages where the passenger-carrying vehicle is an aircraft.

From a third aspect, this invention provides a seating component comprising a seat and a footwell, the footwell being located to laterally beside the seat. Such a seating component can be used in the provision of an arrangement embodying the first aspect of the invention within a vehicle embodying the second aspect of the invention.

A seating component embodying this aspect of the invention may include a shell. The shell most typically includes a recess that constitutes the footwell.

The shell most preferably is formed as a plastic moulding. In this way, it may be provided with additional functional formations. For example, it typically includes a region to enclose a back of the seat and to enclose operating components of the seat. The shell may also include a formation (amongst other possibilities) that serves as an armrest, a tray, a table, a support for a display monitor and a holder for literature. Where a tray and/or a table is provided by a formation of the shell, it may not be necessary to provide an in-arm table. This allows the space provided to the passenger to be maximised with respect to the overall width of the seating component.

A seating component embodying this aspect of the invention may provide one, two, three or more seating positions. Embodiments that provide one seating position typically have one seat and one footwell. Embodiments that provide two seating positions may include three footwells, and these may be used in alternate rows with seating components that provide three seating positions and two footwells.

The seat provided in embodiments of the invention is typically movable between an upright position and a reclined position. In the reclined position, the seat may provide a substantially flat sleeping platform. This is advantageously disposed horizontal or at a shallow angle, such as a few degrees (e.g. 2°) from horizontal when in normal use. Note that an aircraft normally flies with its nose slightly high such that the floor is a few degrees (say, 3°) from horizontal. Therefore, to obtain a level bed in normal flight, the sleeping platform must slope downwardly with respect to the floor in a forward direction.

Embodiments of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings, in which:

Figure 1 is a seating plan showing a seating arrangement in Zone A of an Airbus A340-600 aircraft;

Figure 2 is a seating plan showing a seating arrangement in Zones B and C of an Airbus A380 aircraft;

Figure 3 is a transverse detailed view of seats in the embodiments of Figure 1 and Figure 2 in an upright and a reclined position;

Figure 4 is a detailed plan view of seats in the embodiments of Figure 1 and Figure 2 showing them occupied when in the reclined position;

Figure 5 and Figure 6 are cross-sectional views on, respectively, lines A-A and B-B of Figure 3;

Figure 7 and Figure 8 are part cut-away, perspective views of seats in the embodiments of Figure 1 and Figure 2 showing seats in both upright and reclined positions;

Figure 9 illustrates an arrangement of seating in the embodiment of Figure 1 or Figure 2 in the region of a cooking galley;

Figures 10, 11 and 12 illustrates an arrangement of seating in the embodiment of Figure 1 or Figure 2 in the region of a lavatory enclosure; and

Figure 13 is a plan view that serves to compare a conventional seating arrangement with one embodying this invention.

As shown in Figure 1, seating Zone A in an Airbus A340-600 (r. t. m.) aircraft is provided with a total of sixty-six seating positions. As shown in Figure 2, seating Zones B and C of the upper deck of an Airbus A380 (r. t. m.) aircraft are provided respectively with seventy-three and thirty-two seating positions. Much of the following description applies to both of these embodiments.

The seats are arranged in three groups, two outer groups 10, 12 and an inner group 14, separated by two aisles 16, 18. Within each group, the seats are arranged in rows that extend transversely of the principal axis X of the aircraft. The rows are spaced with a pitch of 1016 mm (40 inches). Thus, an outer row 10 of fourteen seats in the embodiment of Figure 1 has an overall length of 13208 mm (520 inches). Within each outer group 10, 12, each row includes one seating position. In the inner group 14, the rows include alternately two seating positions and three seating positions.

The immediately following description applies to a typical seating position within a group. Seating positions at the front row and rear row of each group differ, and will be described separately below.

Each seating position includes a forward-facing seat 20 and a footwell 22. Within the row, each seat 20 is disposed, in a transverse direction, adjacent to a footwell 22 associated with a seating position of the row immediately behind.

As shown in Figure 3, each seat 20 can adopt a range of positions, from an upright position to a fully reclined position (both being shown in Figure 3). The seat comprises a back 26 and a squab 28 that form the back and base of the seat when in the upright position. The seat further includes a leg support pad 30. In the upright position, the leg support pad 30 extends, out of use, downwardly from a front edge region of the squab 28. Conveniently, a life jacket 34 can be carried on the leg support pad 30 beneath the squab 28.

The back 26, squab 28 and leg support pad 30 are carried on a linkage 32. The linkage 32 serves to control movement of the components carried upon it at the seat moves between its upright and reclined positions, the movement being driven by an electric motor 34. The design of such linkages is well-understood, and since it is not central to the invention, it will not be described in detail. However, in this embodiment, it is important that the back 26 of the seat does not move (or moves only minimally) rearwards as the seat moves from its upright to its reclined position. Movement to the reclined position is achieved by a downward and forward pivoting movement of the back 26, a predominantly forward movement of the squab 28, and an upward pivoting movement of the leg support pad 30. When reclined, the back, squab 28 and leg support

pad 30 form an approximately flat sleeping platform of length approximately 1880 mm (74 inches) that is angled at a few degrees (say, 2°) from the horizontal while the aircraft is in normal level flight. (This is achieved by its being at an angle of approximately 5° to the floor.) In such a position, the leg support pad 30 extends into the footwell 22. In general, it is desirable to provide a sleeping platform that is as close to horizontal as possible.

Within the footwell 22 there is a platform 40 that has an upper surface that is parallel to the floor of the aircraft at a height of approximately 183 mm (7.2 inches) and width of approximately 307 mm (12.1 inches). When the seat 20 is in the reclined position, the an edge of the leg support pad 30 that is furthest from the squab 28 is adjacent to and level with the platform 40, such that the platform can serve as an extension of the sleeping platform that is provided by the reclined seat.

Figure 4 shows the seating arrangement described above occupied by passengers. The torso and head of a person (identified as P1 in Fig. 4) occupying a seat in a first row is adjacent to the legs of passengers (P2, P3) in an immediately rearward row. Since the width of the footwell 22 is less than the width of the seat, this allows a more efficient use of space than is possible with seating arrange conventionally in transverse rows. (A comparison of an embodiment of the invention and a conventional arrangement is shown in Figure 13.)

The shapes and dimensions of the seating positions in this seating arrangement are shown in detail in Figures 5 and 6. The width of the space that is provided for each passenger in the reclined seat at shoulder height is 602 mm (23.7 inches). Within the footwell, the width is 307 mm (12.1 inches). The depth of the footwell is 360 mm (14.2 inches). Also illustrated in these drawings are possible locations for the seat electric box (SEB) and the in-flight entertainment box (IFE).

Further details of the implementation of the invention will now be described.

Four distinct types of seating components are provided in each embodiment. Within the inner group 14, alternate rows have two seats (and three footwells) and three seats (and two footwells). An end part of each type of row is shown in Figure 7 at A and B, respectively. Within the outer groups 10, 12, each row has one seat. Alternate rows

have the seat to the left (looking forward) and to the right of the footwell of the row behind. These are shown, respectively, at C and D in Figure 8. The construction of each of these assemblies is similar, and will now be described.

The seating assemblies each comprise a moulded plastic shell 50. The shell 50 has formations that constitute several functional components.

First, the shell 50 has a respective upright concave (to the front) region 52 for each seat - thus, each shell 50 may have one, two or three such regions. Each concave region may have an aperture 64 formed through it at an upper part. In this embodiment, two such apertures are provided on each concave region. Such an aperture can be used as a hand-hold by passengers walking in the aisles or while gaining access to or exiting from the seat, and they can also contribute to the aesthetic design of the seating components. The upright concave region covers the rear of the seat back 26 when it is in its upright position, and extends downwardly to enclose the linkage 32 and the motor 36.

When viewed from the front, the shell 50 has a forwardly-projecting buttress portion 56 that has a rectangular cross-section. The buttress portion extends adjacent to the squab 28 of the seat when it is in the upright position. An upper surface of the buttress, at a height approximately 729 mm (28.7 inches) above the floor level, has longitudinally extending convex formation 58 adjacent to each of the seats. Each convex formation 58 provides an armrest for a person in the adjacent seat when it is upright. At its forward extent, the buttress has a flat-topped region. This flat-topped region carries a tray assembly 60. The tray assembly 60 can provide a small tray surface when disposed in a folded position upon the buttress 56. Furthermore, it has two leaves 60 that can be folded out across the adjacent seat 20 (see 62 in Figure 7) to provide a larger tray surface approximately 698 mm (27.5 inches) above floor level, for example, for serving a meal. An egress space of 216 mm (8.5 inches) is provided between the front of each buttress 56 and the rear of the shell 50 in front.

When viewed from the rear, the buttress 56 presents a forwardly extending recess 54 that opens rearwardly. The recess constitutes the footwell for a seating position to the rear. A flat support member 62 extends transversely across an upper part of the recess to form a storage pocket, taking the place of the pocket that is normally provided on the

back of a conventional aircraft seat. The support member 62 slopes down in a forward direction with respect to the floor at an angle of a few degrees. This is to resist the tendency of articles to fall from the storage pocket while the aircraft is accelerating for takeoff or when climbing.

An upright web portion 66 of the shell 50 extends between adjacent concave portions 52. A corresponding upright portion 68 extends adjacent to the concave portion 52 of the one-seat seating assemblies and outwardly from outer sides of the concave regions 52 of the two-seat seating assemblies. As will be understood, each such upright portion 68 is positioned in front of a respective seat in the row behind. It can therefore be used to carry a display screen 70 in a position that can be conveniently viewed by an occupier of that seat.

Adjacent to each aisle 16, 18, the shell has a forwardly extending arm portion 74 that extends beside the squab 28 of the seat when in the upright position. An upper surface of the arm portion 74 is formed as a lip that turns in above the seat squab 28 to serve as an armrest. In consequence, the width of the squab 28 can be greater than the distance between the arms. For example, the squab may be 570 mm (23.5 inches) wide, while the distance between the arms may be 554 mm (21.8 inches). Moreover, there is no in-arm table to add to the width of the seat.

This provides the occupier of the seat with width where they benefit it most – in the region of their hips when seated and shoulders when sleeping -- and provides adequate, but reduced, width where it is less important – in the footwell when the seat is reclined. As compared with a conventional arrangement, each passenger occupies less floor space, yet the transverse distance between each passenger is greater (for example, up from 150 mm to 254 mm (6 inches to 10 inches), giving the passenger an increased perception of space. The shell also provides the occupier with a personal enclosed space, this further contributing to a feeling of comfort.

The overall width of a single seat and two adjacent footwells in this embodiment is approximately 1458 mm (57.4 inches), and a double seat with a single intermediate footwell is approximately 1532 mm (60.3 inches). A single seat and footwell component has an overall width of approximately 952 mm (37.5 inches)

Special measures are taken at the front and rear ends of each group of seats to optimise the use of space.

Figure 9 shows an arrangement that can provide an efficient arrangement for a central aisle that ends immediately to the rear of a transverse galley 80. This is not required in the arrangements shown in Figures 1 or 2, but may be applicable to installations embodying the invention in other aircraft. The galley 80 has a rear bulkhead wall 82. The aim of the arrangement provided in embodiments of the invention is to minimise the clear distance that must be left between the bulkhead 82 and the first row of seats.

In order to provide a footwell for each of the seats in the front row, a respective recess 84 is formed in the bulkhead 82 in front of each seat. The recess is of dimensions similar to the footwell recesses described above. Within the galley, there is a projecting abutment corresponding to each recess. A display monitor 70 can be mounted on the bulkhead above the recess 84.

To minimise the intrusion into the galley space, regions between adjacent recesses can be used to store galley trolleys, and the space above the abutments can be used as a genera purpose storage space, including, for example, stowage cupboards.

Likewise, when a front row approaches a lavatory enclosure, as labelled 'A' in Figures 1 and 2, or a store cupboard, particular measures can be taken to optimise the use of space. Figures 10 to 12 are views from various vantage points of one such arrangement with respect to a lavatory enclosure 86 at the front of the outer group 14. Once again, the objective is to minimise the longitudinal distance between a rear bulkhead 88 of the enclosure and the front seat.

As with the galley, a recess 90 is formed in the bulkhead 88 to constitute a footwell. The corresponding abutment within the lavatory enclosure 86 has a top surface that can provide a table-top surface for a person within the enclosure. Alternatively, the space above the abutment may be enclosed for use as stowage space or housing for equipment.

At the rear of a group, the seat can be mounted close to a bulkhead since no extra space is needed to allow the seat to recline. If there is sufficient space to gain access to it, the unused rear footwell may provide additional storage space.

The invention is not limited to the embodiments described herein which may be modified or varied without departing from the scope of the invention.

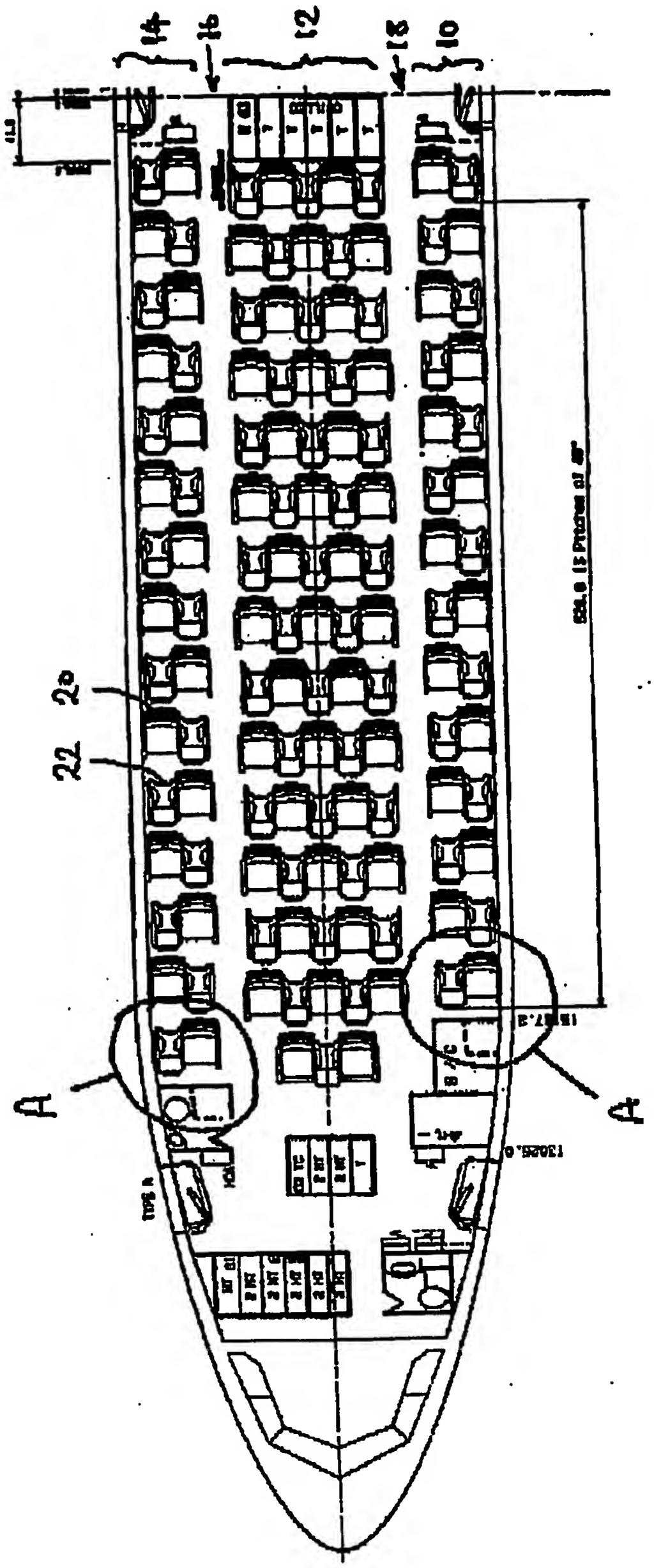

Fig 1

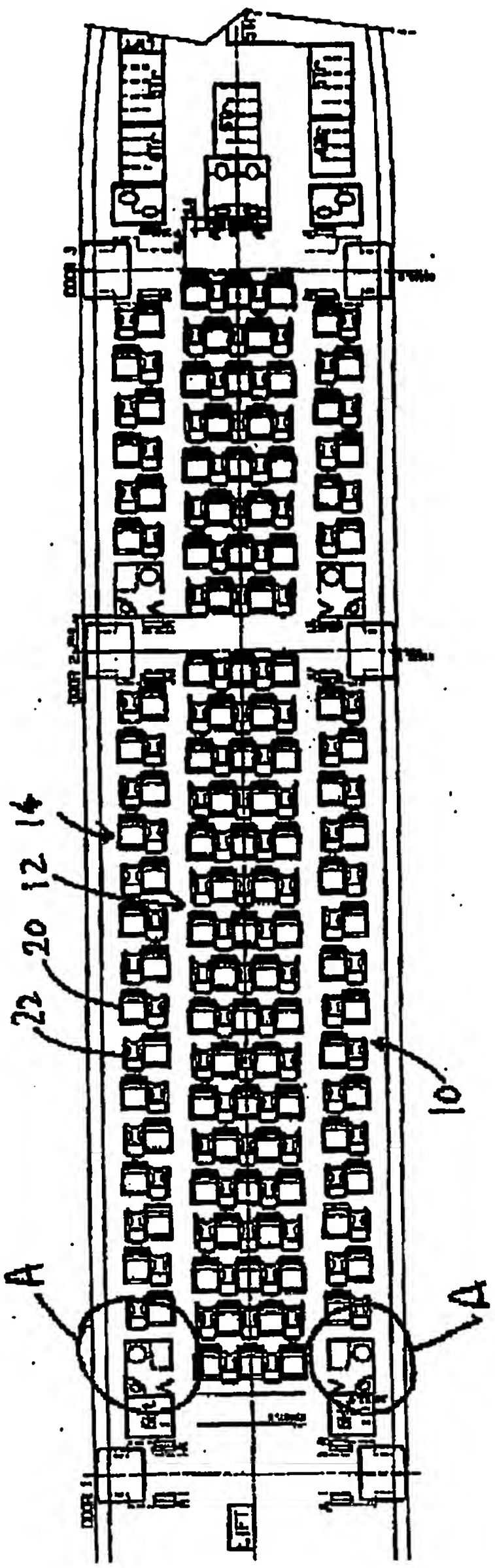

Fig 2

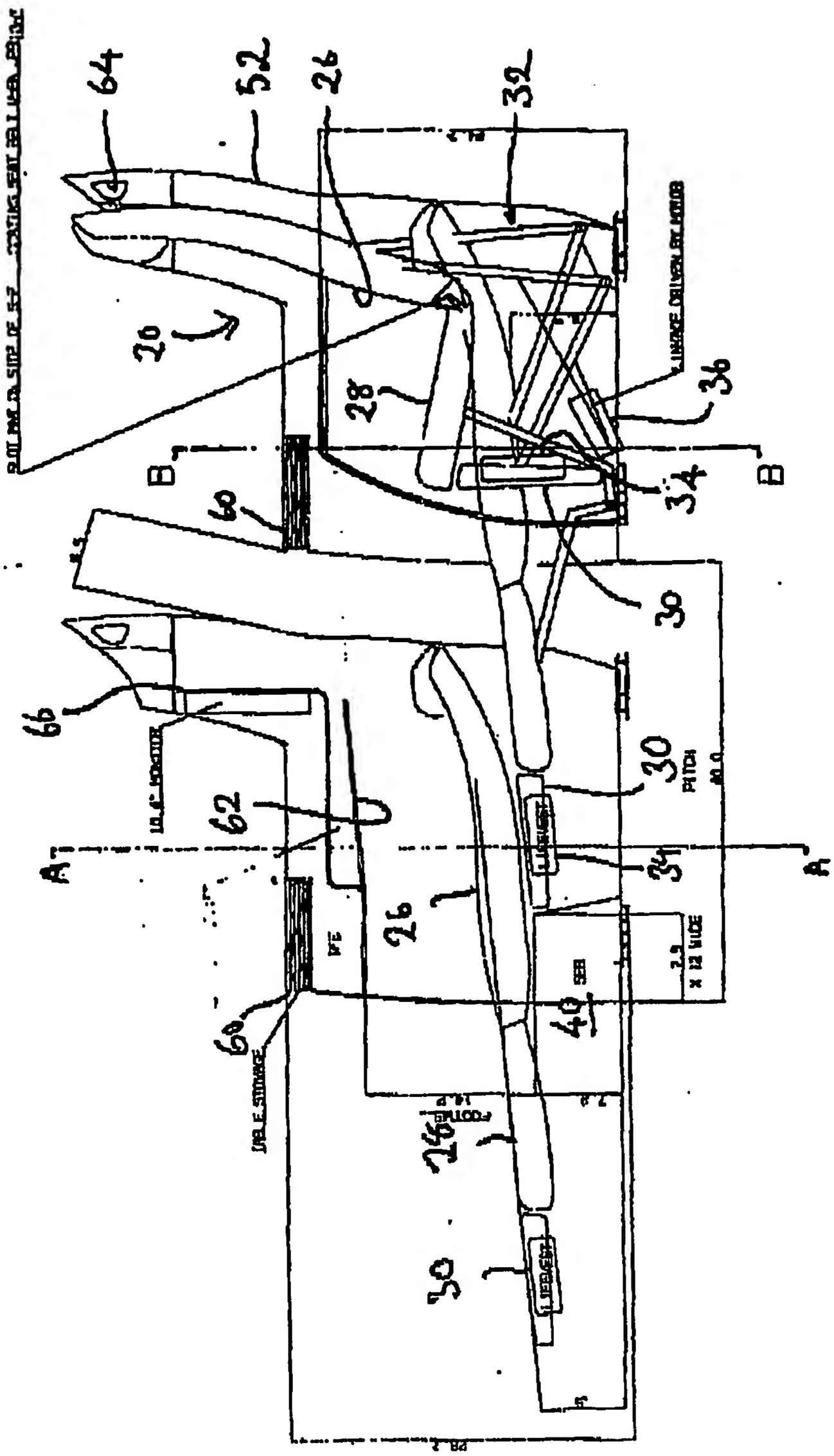
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Fig 3

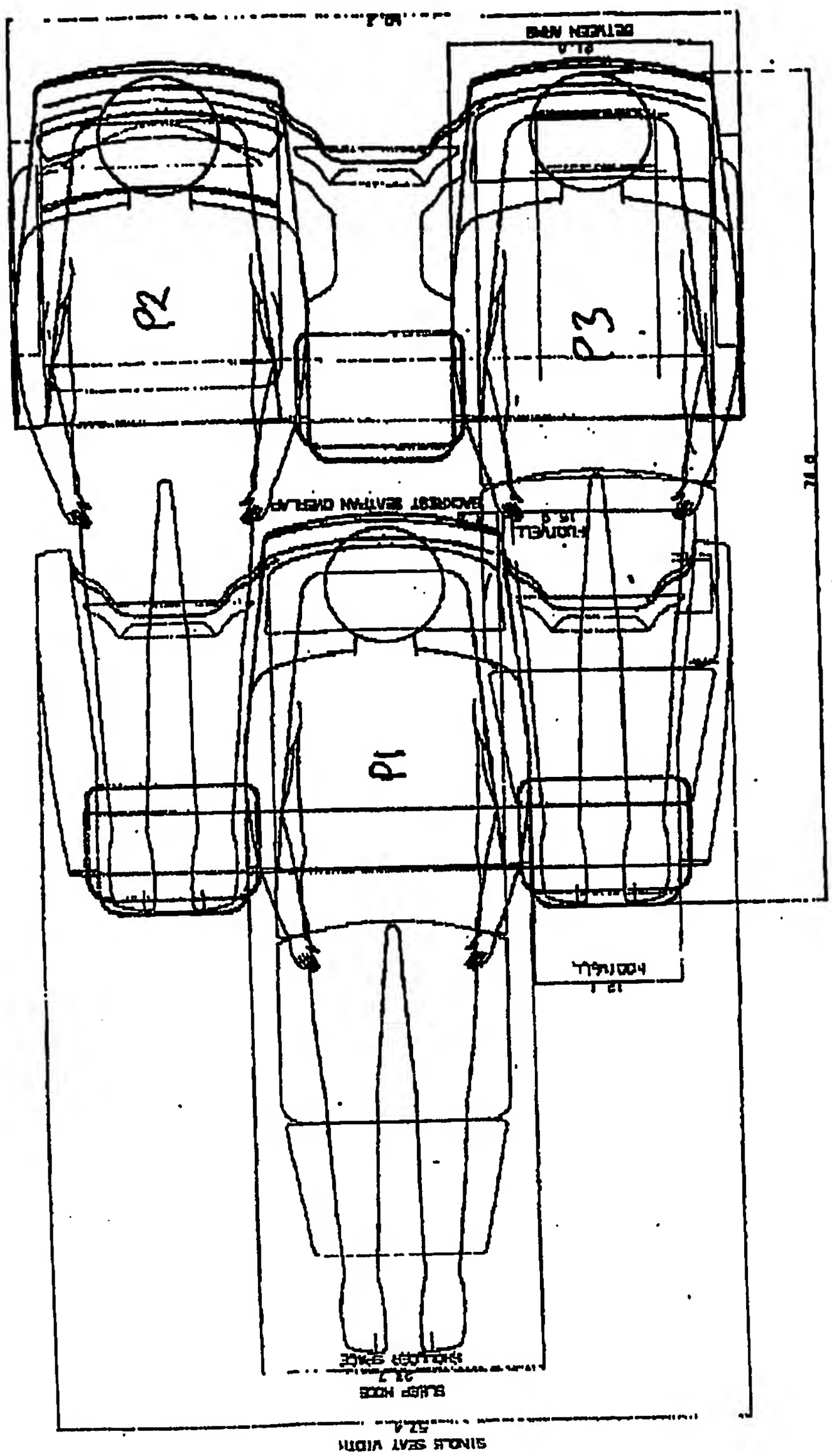
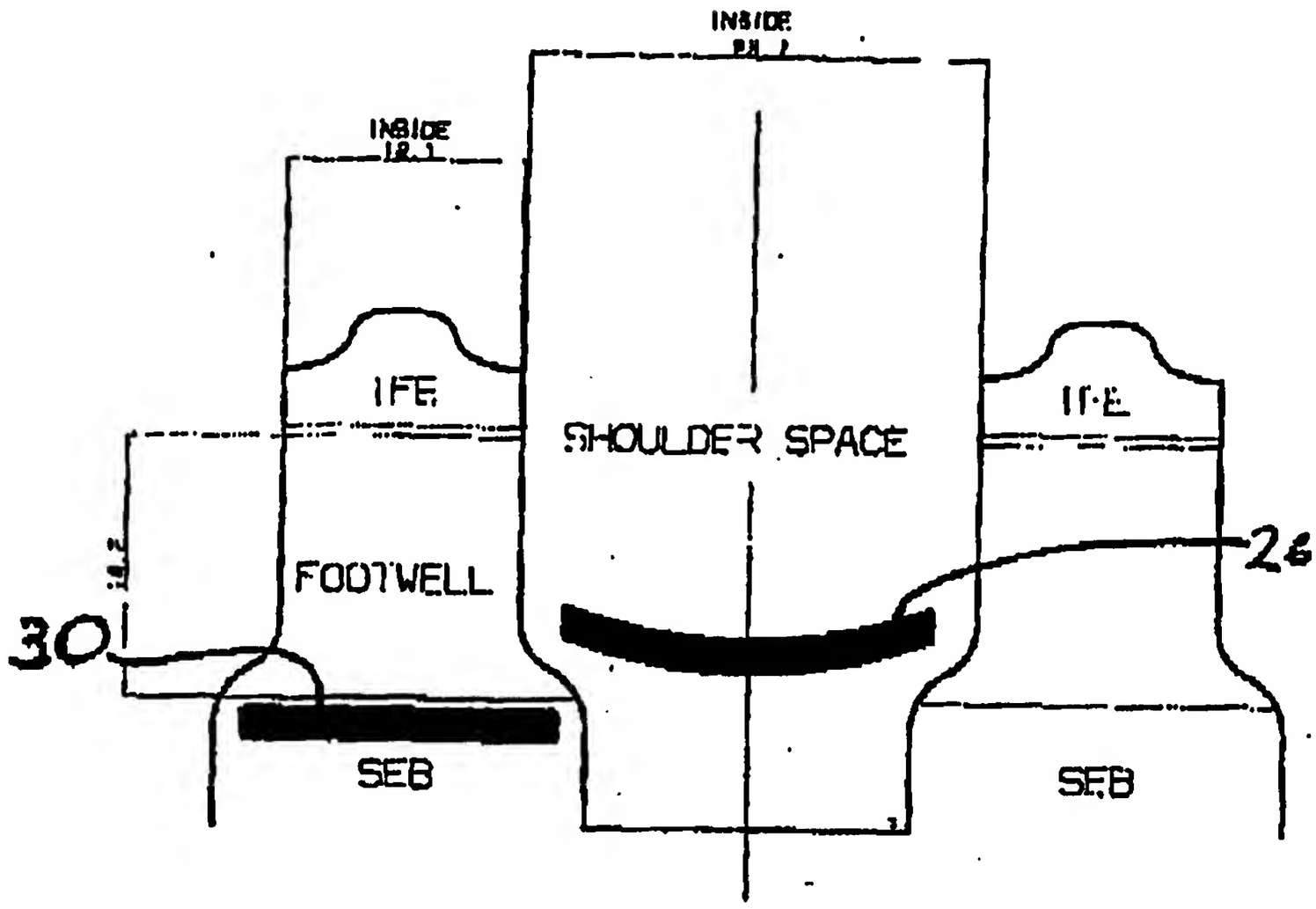
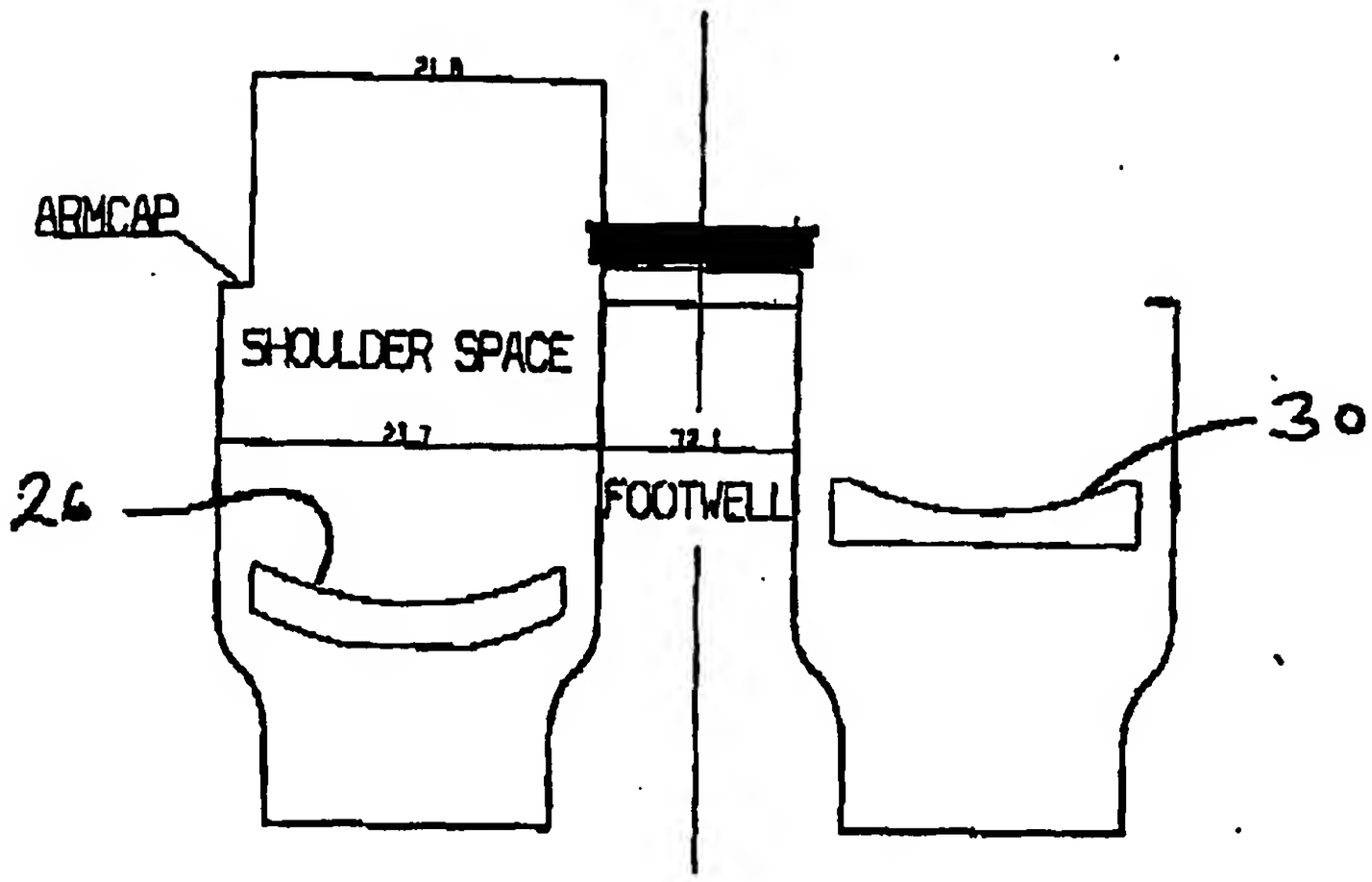


Fig 4



SECTION CUT A/A

Fig 5



SECTION CUT B/B

Fig 6

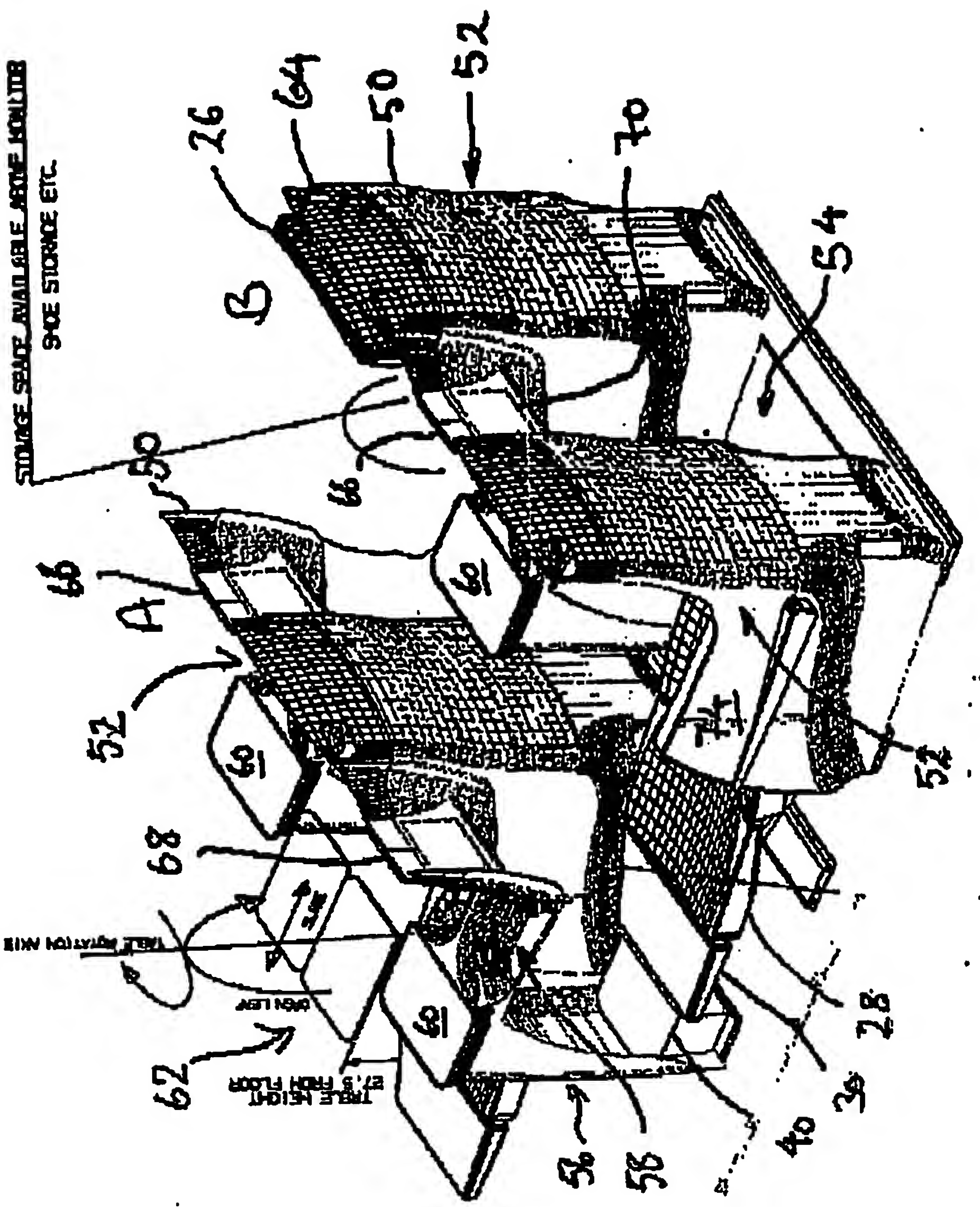

STORAGE SPACE AVAILABLE ABOVE MONITOR
SHOE STORAGE ETC.
TABLE HEIGHT
27.5 FROM FLOOR
TABLE ROTATION AXIS
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Fig 7

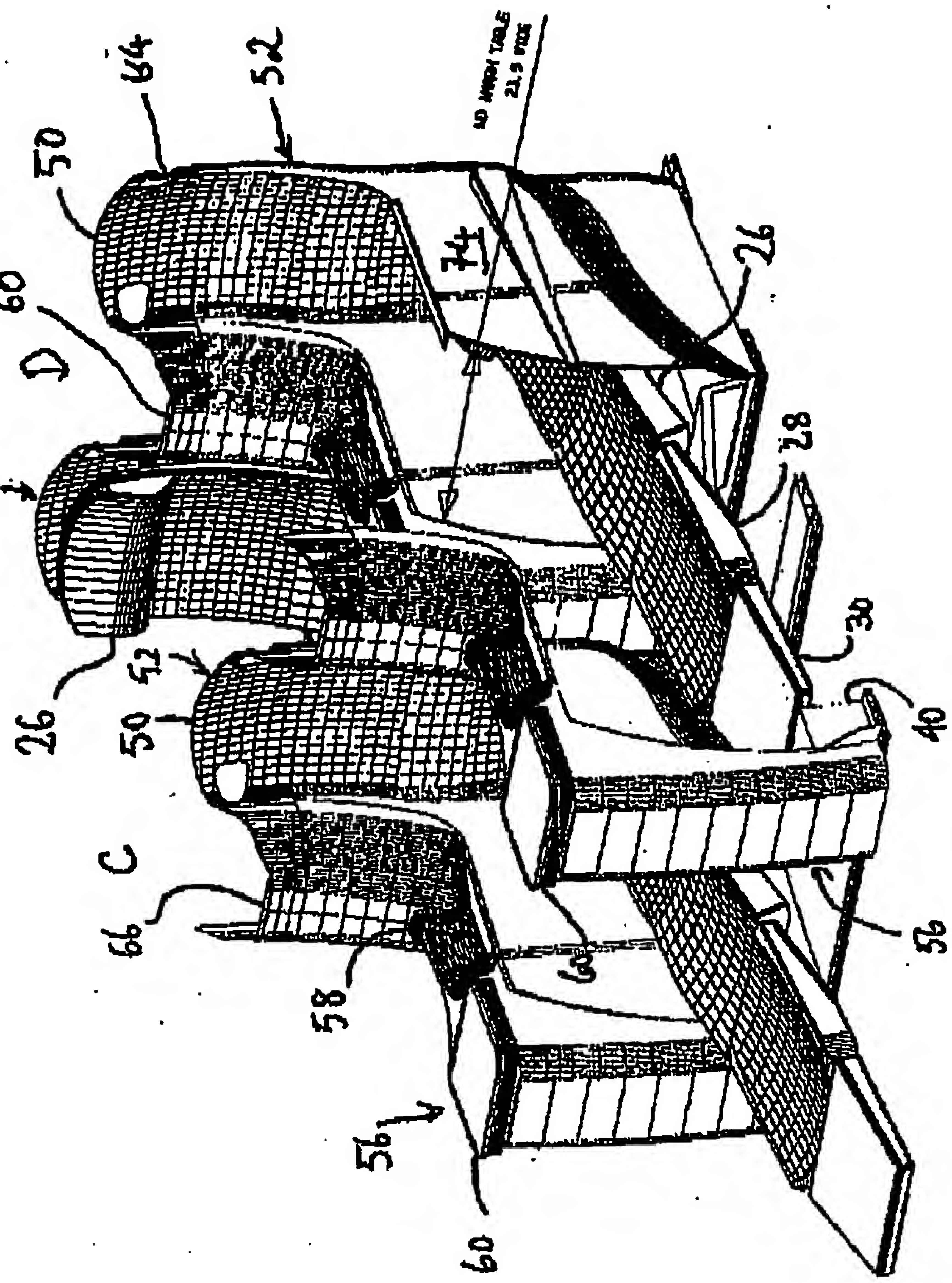

Fig 8

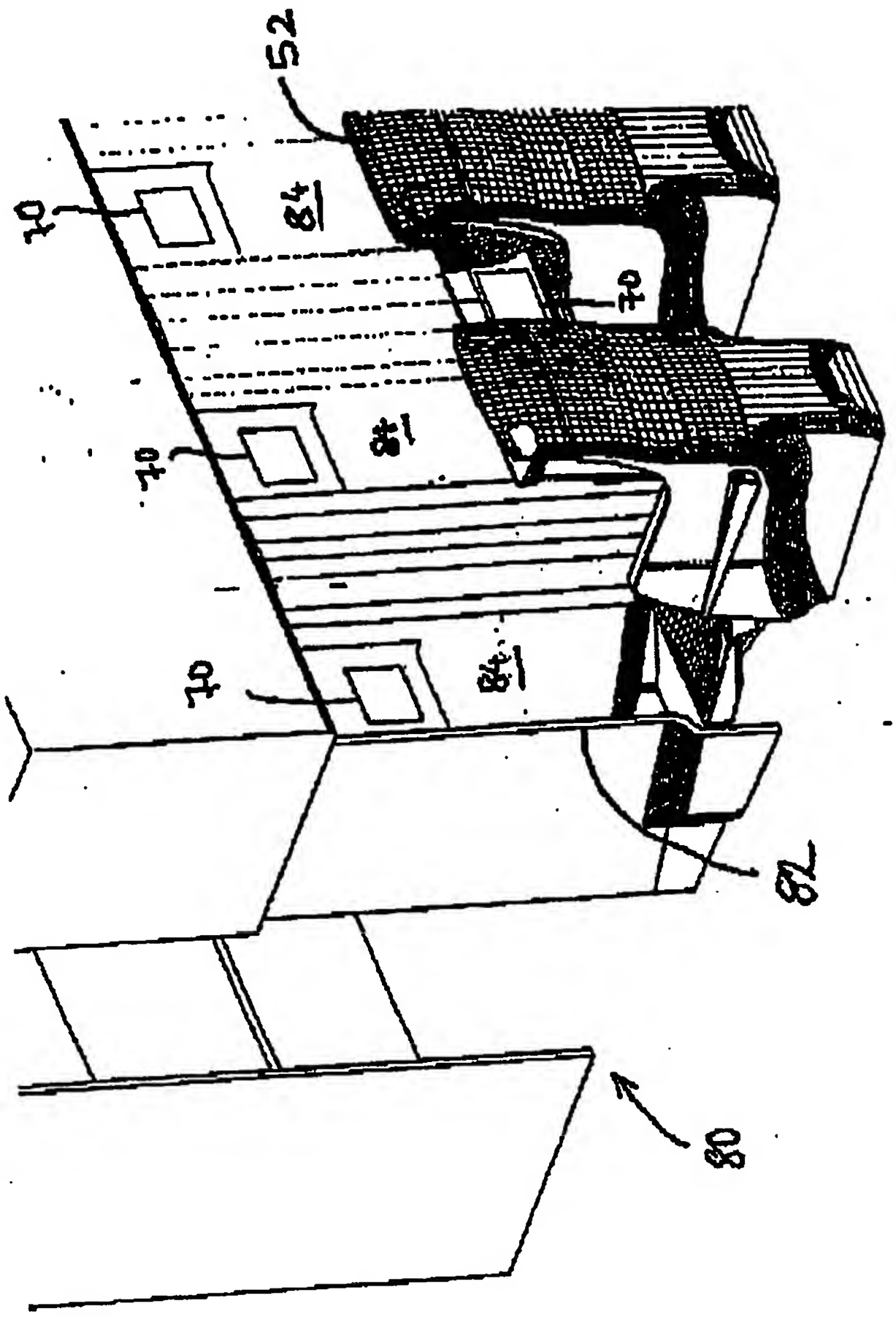

Fig 9

10/13

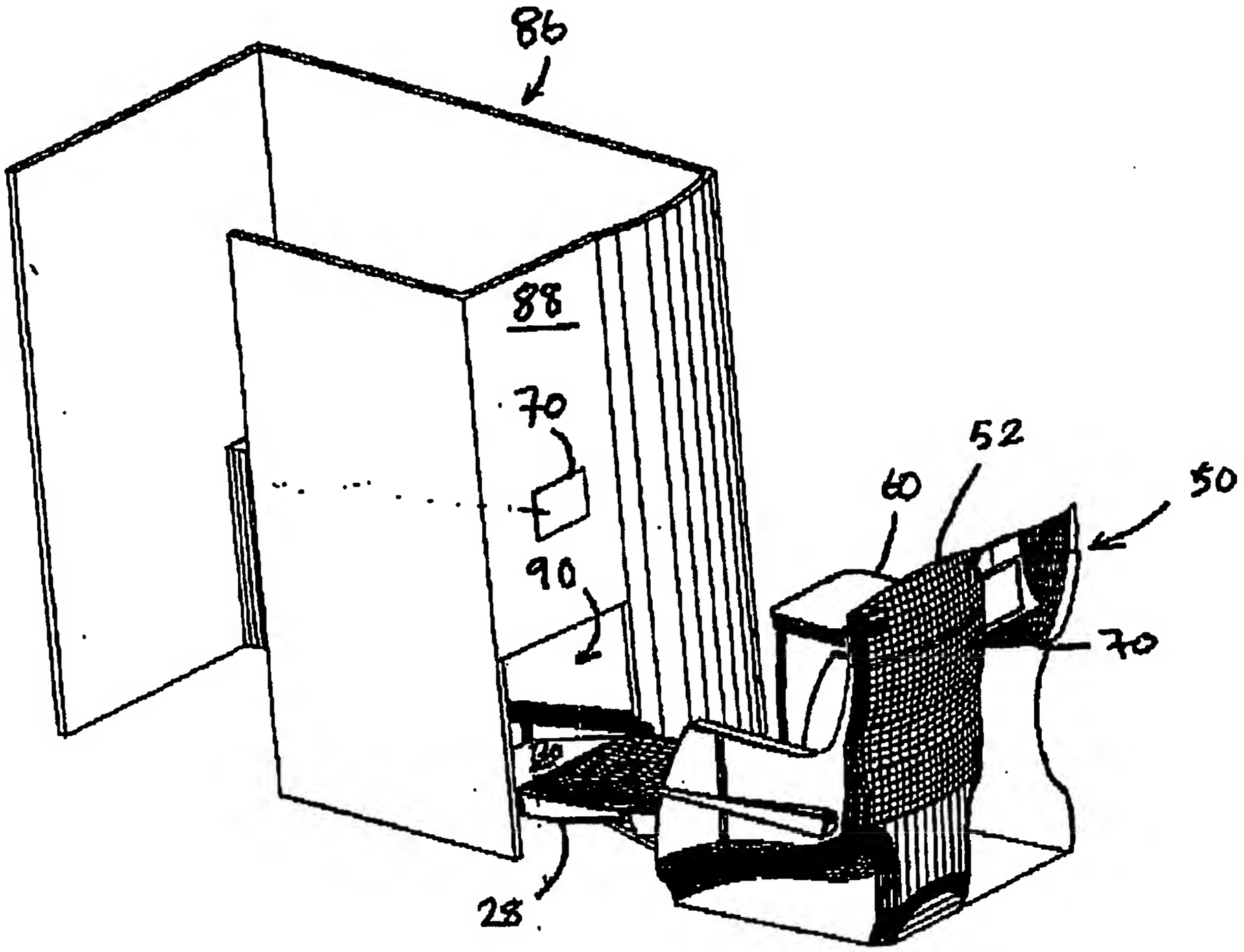

Fig 10

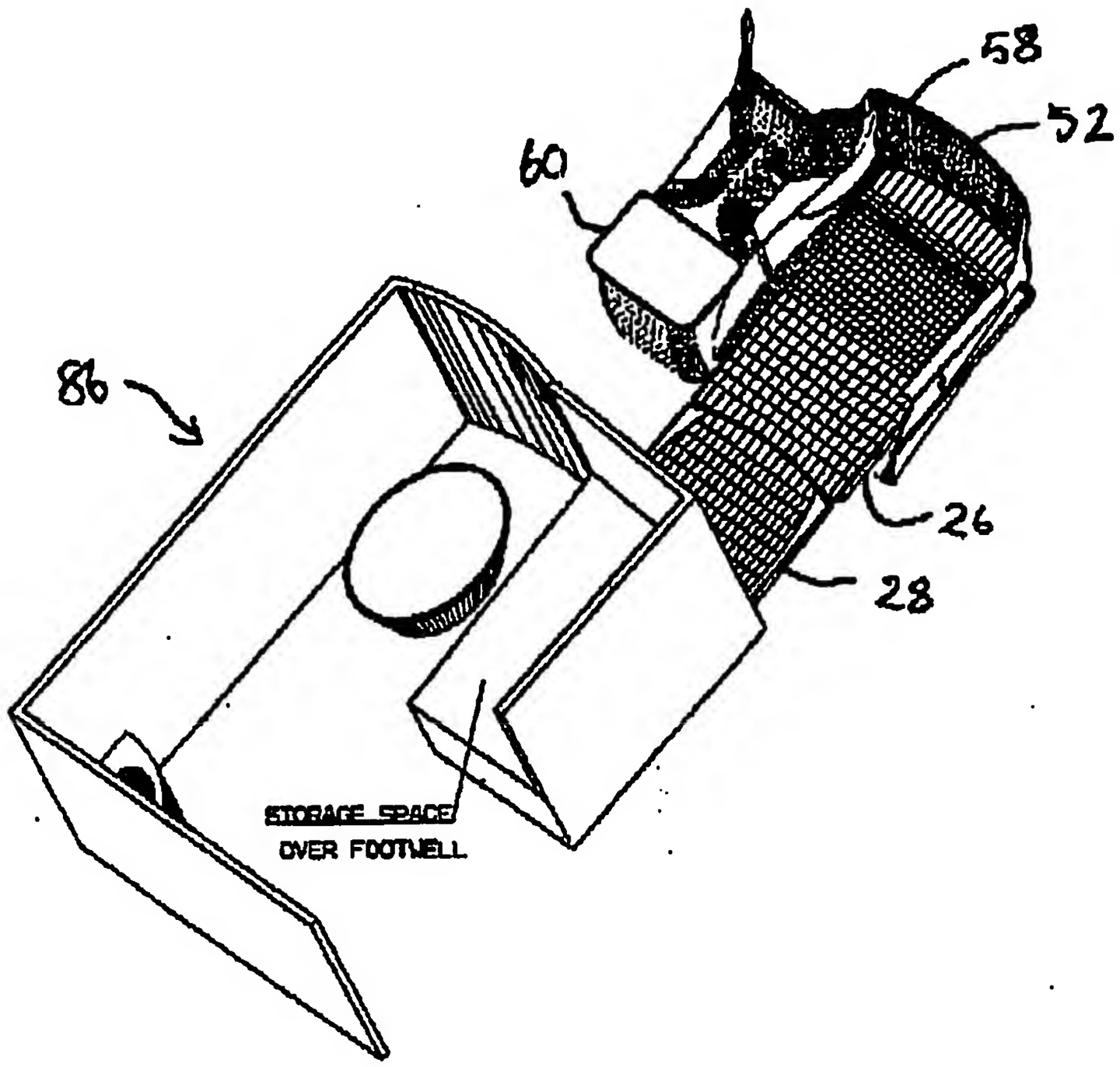

Fig 11

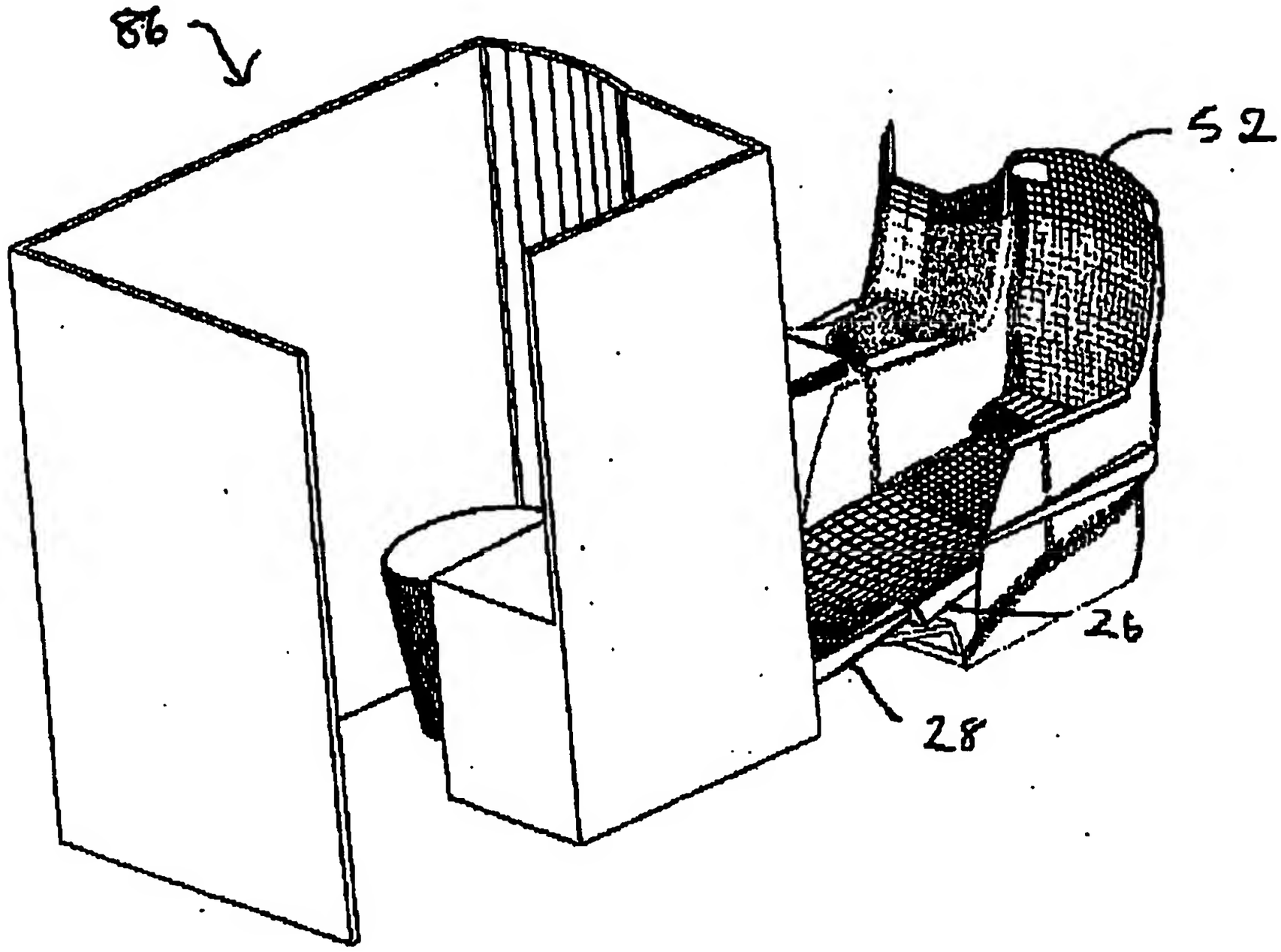

Fig 12

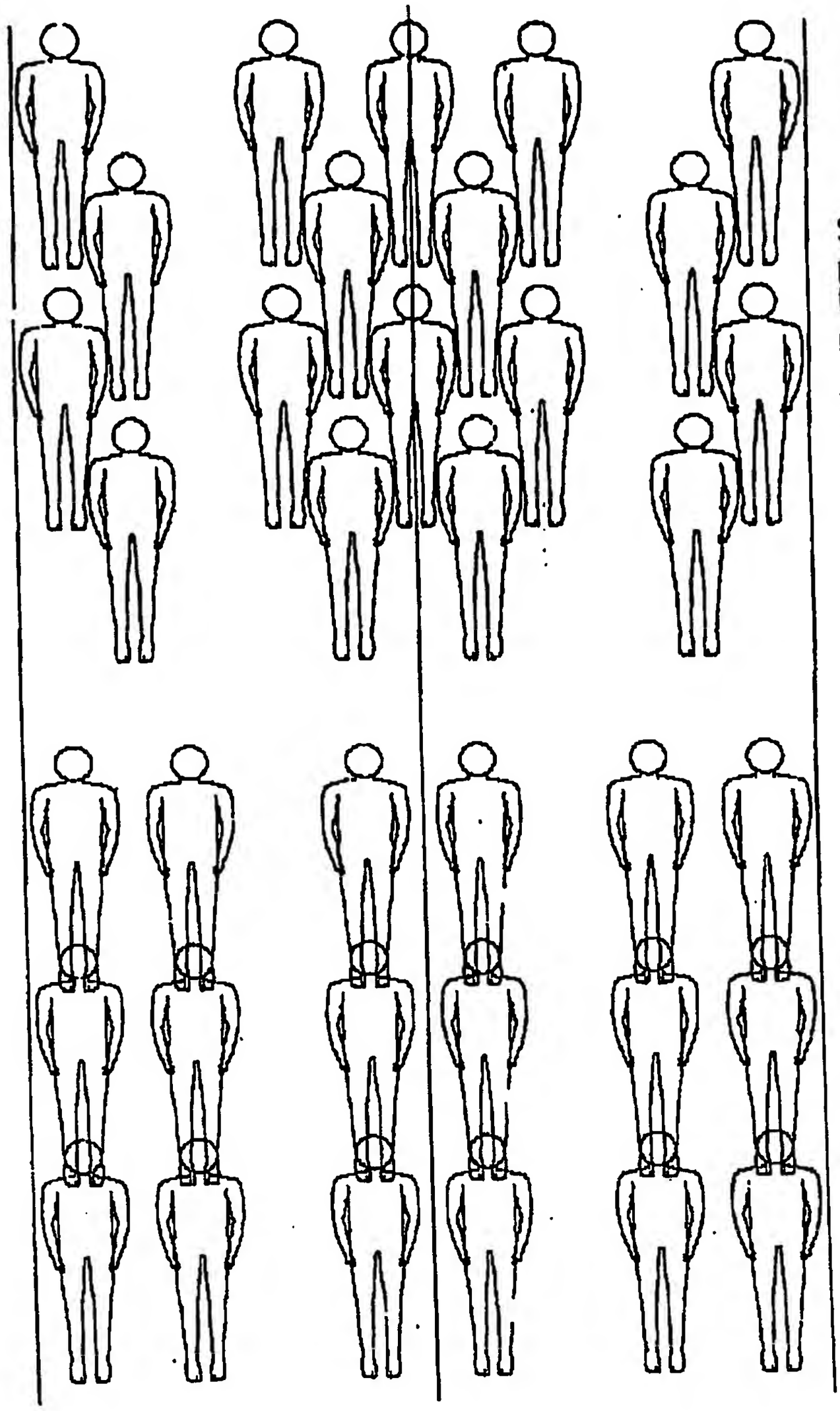

Fig 13